

**Indian Farmer**

Volume 11, Issue 01, 2024, Pp. 19-24  
Available online at: [www.indianfarmer.net](http://www.indianfarmer.net)  
ISSN: 2394-1227 (Online)

**Popular Article****How to grow a superfood and climate resilient crop: quinoa ?**

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Received:27/12/2023

Published:07/01/2024

**Abstract**

Quinoa is recognized as a crop of great value in terms of high nutritional value and tolerance to abiotic stresses which increase the interest to introduce it in marginal agricultural production systems worldwide. Even today, the nutritive properties of the Quinoa seed are seen as a way to fight malnutrition worldwide. In this brief communication, an attempt was made to describe the overall cultivation system of quinoa in India.

**Key words:** Sowing to Harvesting, Nutritional value, Quinoa seeds

**Introduction:**

Quinoa or *Chenopodium quinoa* (family Amaranthaceae), a native of South America is a short duration (100 – 130 days) annual species growing up to 2 m tall. It can be grown on marginal soils up-to an altitude of 3800 m and has good tolerance to frost, salinity and drought.

**Nutritional Value of Quinoa Grain**

Highly nutritious (Table 1), outstanding protein quality (Table 2) (rich in amino acids like lysine and methionine that are deficient in cereals) and contain wide range of minerals and vitamins. Quinoa grain has lower sodium but higher calcium, phosphorus, magnesium, potassium and iron than wheat, maize & rice (Table 3). The grain is used primarily as cereal substitute and to make soup, alcohol, while the flour is utilized in making biscuits, bread and processed food. Quinoa starch having small grains and high viscosity, can be exploited for various industrial applications.



Quinoa Plant



Quinoa Seed

Table 1: Nutritional quality of quinoa vis a vis other cereals

Crop	% Dry weight				
	Crude Protein	Fat	Carbo-hydrate	Fiber	Ash
<b>Quinoa</b>	<b>13.8</b>	<b>5.0</b>	<b>59.7</b>	<b>4.1</b>	<b>3.4</b>
Barley	14.7	1.1	67.8	2.0	5.5
Buck wheat	18.5	4.9	43.5	18.2	4.2
Corn	8.7	3.9	70.9	1.7	1.2
Pearl Millet	11.9	4.0	68.6	2.0	2.0
Oats	11.1	4.6	57.6	0.3	2.9
Rice	7.3	0.4	80.4	0.4	0.5
Rye	11.5	1.2	69.6	2.6	1.5
Wheat	13.0	1.6	70.0	2.7	1.8

Table 2: Protein quality of quinoa vis a vis other products

Amino Acid	Amino acid content (g/100g protein)			
	Quinoa	Wheat	Soya	Skim Milk
Isoleucine	<b>4.0</b>	3.8	4.7	5.6
Leucine	<b>6.8</b>	6.6	7.0	9.8
Lysine	<b>5.1</b>	2.5	6.3	8.2
Phenylalanine	<b>4.6</b>	4.5	4.6	4.8
Tyrosine	<b>3.8</b>	3.0	3.6	5.0
Cystine	<b>2.4</b>	2.2	1.4	0.9
Methionine	<b>2.2</b>	1.7	1.4	2.6
Threonine	<b>3.7</b>	2.9	3.9	4.6
Tryptophan	<b>1.2</b>	1.3	1.2	1.3
Valine	<b>4.8</b>	4.7	4.9	6.9

Table 3: Mineral content of quinoa vis a vis other products

Minerals	Mineral content of quinoa, mg/100 g dry weight			
	Quinoa	Maize	Rice	Wheat
Sodium	<b>2.7 - 13</b>	1 - 16	8.00	3.00
Calcium	<b>148.7</b>	17.10	6.90	50.3
Phosphorous	<b>383.7</b>	292.6	137.8	467.7
Magnesium	<b>249.6</b>	137.1	73.5	169.4
Potassium	<b>926.7</b>	377.1	118.3	578.3
Iron	<b>13.2</b>	2.10	0.70	3.80
Copper	<b>0.7 - 10.0</b>	0.19 - 0.21	0.3 - 0.7	0.50
Manganese	<b>1.9 - 33.0</b>	0.50	2.00	5.00
Zinc	<b>4.40</b>	2.90	0.60	4.70

**Agro technology**

Seeds being very small and light weight, nursery is raised in poly tray as shown below.



Poly tray

Sowing of Quinoa seeds

Seedlings post germination

Seedlings ready for transplanting



Land preparation

Seedlings ready for transplanting

Transplanting of seedlings in the field

Field view after transplanting

**Nursery Raising**

Bold and healthy seeds of quinoa are screened and planted in poly trays. One acre plantation require 10,600 plants but seeds for double the number of plants were sown in the poly tray (considering 50% germination and survival). Two seeds are sown (instead of single) in each compartment of poly tray. About 150 gm seeds are required to raise enough seedlings for one acre. Poly trays are filled with coco peat and seeds are sown. A total number of 220 trays (having 98 cups) and 220 kg coco-peat are required for an acre. Watering is done on daily basis using rose can. Poly feed (N : P: K : 19 : 19: 19) at 0.5% is applied using the rose can on seedlings after 10 days. After 2 weeks of growth, the second seedling from the poly tray is removed.

**Transplantations of seedlings**

Seedlings of about 15 cm height (after 6 weeks of growth in the nursery) are transplanted in the field keeping line to line distance of 90 cm. Likewise, the distance between plants within a line is kept at 45 cm.

**Land preparation:**

Land was prepared well through cross harrowing / ploughing. Fertilizers at 40 kg each of P<sub>2</sub>O<sub>5</sub> (250 kg SSP) and K<sub>2</sub>O (67 kg MOP) along with 120 kg Neem cake and 200 kg of vermi-compost are applied per acre through broad casting before final land preparation.

**Watering:**

Laterals (16 mm PVC pipe) are spread at 90 cm apart over the land surface and drippers (2 LPH) are inserted on it at 45 cm interval. Water is supplied at 2 l water per plant per day through drip irrigation during vegetative, reproductive & grain filling phases. Watering is skipped on rainy days.

**Weeding:**

Weeding is done at 20 and 30 days using a mechanical weeder followed by manual removal of broad leaf weeds. Further after 60 days weeds are removed manually with labor.



Inter culture with mechanical weeder

Field view after weeding

**Pesticide application:**

Quinoa is susceptible to sucking pests like aphids, thrips, whiteflies, etc and leaf eating caterpillar. Dimethoate or monocrotophos at 0.3% are sprayed at intervals of 15 , 30 , 45 and 60 days to control the incidence of pests. Yellow coloured virus infected plants were removed and destroyed as visible.



**Pest infestation**



**Pesticide spraying**

**Fertilizer application:**

Poly feed (1 kg) is supplied through drip system at weekly interval. Total 16 applications was done.



**Fertilizer mixing**



**Fertilizer supply through drip system**

**Harvesting**

Plants have a sorghum-like seed head at maturity. It is done when the seed can barely be dented with a fingernail and plants have dried, turned a pale yellow or red color, and leaves have fallen on to the ground. The seeds easily get separated from the head at this time. Because of indeterminate growth habit, matured seed heads are only harvested in 3 / 4 phases at 105, 110, 115 and 120 days. Irrigation is withheld 5 – 7 days before harvesting.



**Harvesting**

**Threshing:**

Seed heads are dried under the sun for 2 – 3 days and beaten with wooden sticks. Seeds are separated from the flower head through threshing and winnowing.



**Threshing & winnowing**

Quinoa contain saponins, bitter in taste, which are concentrated in the seed coat and must be removed before consumption. The most popular method for removing saponins involves by washing the grains with water.

The seed is soaked in water for 8 hours in the ratio of 1:2 (quinoa : water). After soaking, the seeds are rubbed with hands to remove the seed coat and then washed under tap water for 2 - 3 times. Washed grains are dried under the sun dry for 2-days. Seed loss was up to 20 % on weight basis during washing.



**Soaking in water**

**Yield Potential and Performance Results:**

Maximum grain yield of about 1000 kg / acre may be obtained.



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